CLAIMS

What is claimed is:

1.      A system for monitoring rotating machinery having a shaft and circumferentially disposed extensions rotatable with said shaft and spaced apart from one another, the system comprising:

a plurality of proximeters positioned proximate to said rotating machinery and operable to measure and transmit resonant vibration frequency and amplitude data derived from a transit time between said individual rotating extensions, along with signal amplitude data; and

a processor electrically coupled to receive said data and configured to correlate said data and thereby produce an assessment of operational health for said machinery.

2.      A system according to claim 1, wherein said processor assessment includes a remaining operational life prediction for said machinery.

3.      A system according to claim 1, wherein said processor assessment includes a maintenance schedule for said machinery.

4.      A system according to claim 1, wherein said resonant vibration data includes radial runout data for said shaft.

5.     A system according to claim 4, wherein said rotating machinery comprises a gearbox comprising a gear having multiple teeth, and said radial runout data indicates radial positions of said teeth.

6.     A system according to claim 1, wherein said rotating machinery includes a rotating shaft, and said processor correlates said resonant vibration data and radial runout data for said shaft.

7.     A system according to claim 6, wherein said proximeters further measure and transmit axial movement data for said shaft.

8.     A system according to claim 7, wherein said rotating machinery comprises a gearbox comprising a gear having multiple teeth, and said proximeters further measure and transmit axial movement data.

9.     A system according to claim 1, wherein said processor correlates said resonant vibration data and axial movement data for said shaft.

10.     A system according to claim 1, wherein said proximeters are electromagnetic proximeters.

11.     A system according to claim 1, wherein said proximeters are capacitive proximeters.

12.     A system according to claim 1, wherein said proximeters are optical proximeters.

13.     A system according to claim 1, wherein said proximeters are fiber optical proximeters.

14.     A system according to claim 1, further comprising:

multiple rotating machinery components having a shaft and circumferentially disposed extensions rotatable with said shaft and spaced apart from one another; and

additional proximeters, positioned circumferentially apart from one another and proximate to different respective components, and operable to measure and transmit nonduplicative resonant vibration and amplitude data for each of said rotating extensions along with signal amplitude data for said multiple rotating machinery components.

15.     A system according to claim 1, wherein said rotating machinery comprises a gearbox comprising a gear having multiple teeth.

16.     A system according to claim 15, wherein said processor assesses the operational health of each of said teeth.

17.     A system according to claim 16, wherein said gearbox comprises at least two gears that mesh at a meshing point, and at least one of said proximeters is disposed at a location approximately 180° from said meshing point.

18.     A system according to claim 1, further comprising:

a housing having an interior space in which said rotating machinery is disposed, and a wall defining at least a portion of said interior space and separating said proximeters from said rotating machinery.

19.    A system according to claim 18, wherein at least one of said proximeters is an electromagnetic proximeter, and said wall has a blind hole extending partially through said wall in which one of said electromagnetic proximeter is disposed.

20.    A system according to claim 1, wherein at least one of said proximeters is exposed to said rotating machinery.

21.    A system according to claim 1, wherein said processor compares said measurements with predetermined values to assess said rotating machinery operational health.

22.    A system according to claim 21, wherein said predetermined values include previously accumulated resonance data, including established maximum values for acceptable machinery fatigue levels.

23.    A system according to claim 22, wherein said resonance data comprises vibration frequency data.

24.    A system according to claim 22, wherein said resonance data comprises circumferential vibration amplitude data.

25.    A system according to claim 22, wherein said predetermined values further comprise values for a radial gap between a gear tooth and a housing in which said gear tooth is housed.

26.    A system according to claim 1, further comprising:

an alerting signal generator that produces a signal reporting said rotating machinery operational health.

27.    A system according to claim 26, wherein said alerting signal comprises instructions for maintaining said rotating machinery.

28.    A system according to claim 26, wherein said alerting signal comprises a textual, audio, or video signal.

29.    A system according to claim 26, wherein said alerting signal automatically halts action of said rotating machinery.

30.    A system according to claim 1, wherein said processor is configured to detect rotating machinery chatter.

31.    A system according to claim 30, wherein said processor is configured to detect a frequency and amplitude of said machinery chatter.

32.    A system according to claim 31, wherein said processor is configured to assess lubricity degradation for said rotating machinery based on said machinery chatter.

33. A system according to claim 1, wherein said rotating machinery comprises a gearbox comprising a gear having multiple teeth, and said proximeters are spaced at odd harmonics of the resonance frequency quarter wavelength of said teeth.

34. A method for monitoring rotating machinery having a shaft and circumferentially disposed extensions rotatable with said shaft and spaced apart from one another, the method comprising the steps of:

positioning a plurality of proximeters proximate to said rotating machinery, said proximeters being operable to measure and transmit resonant vibration and amplitude data derived from a transit time between said individual rotating extensions, along with signal amplitude data;

receiving and correlating said data using a processor that is electrically coupled to said plurality of proximeters; and

producing an assessment of operational health for said machinery based on said measurements using said processor.

35. A method according to claim 34, wherein said assessment includes a remaining operational life prediction for said machinery.

36. A method according to claim 34, wherein said processor assessment includes a maintenance schedule for said machinery.

37. A method according to claim 34, wherein said rotating machinery includes a rotating shaft, and said resonant vibration data includes radial runout data for said shaft.

38.    A method according to claim 37, wherein said rotating machinery comprises a gearbox comprising a gear having multiple teeth, and said radial runout data indicates radial positions of said teeth.

39.    A method according to claim 34, wherein said processor correlates said resonant vibration data and thereby produces radial runout data for said shaft.

40.    A method according to claim 34, wherein said rotating machinery includes a rotating shaft, and said resonant vibration data includes axial movement data for said shaft.

41.    A method according to claim 40, wherein said rotating machinery comprises a gearbox comprising a gear having multiple teeth, and said axial movement data indicates radial positions of said teeth.

42.    A method according to claim 34, wherein said processor correlates said resonant vibration data and thereby produces axial movement data for said shaft.

43.    A method according to claim 34, wherein said proximeters are electromagnetic proximeters.

44.    A method according to claim 34, wherein said proximeters are capacitive proximeters.

45.    A method according to claim 34, wherein said proximeters are optical proximeters.

46.    A method according to claim 34, wherein said proximeters are fiber optical proximeters.

47.    A method according to claim 34, wherein said positioning step further comprises circumferentially positioning additional proximeters apart from one another and proximate to different respective rotating machinery components having a shaft and circumferentially disposed extensions rotatable with said shaft and spaced apart from one another, said additional proximeters being operable to measure and transmit nonduplicative resonant vibration frequency and amplitude data for each of said rotating extensions of said multiple components.

48.    A method according to claim 34, wherein said rotating machinery is a gearbox comprising a gear having multiple teeth.

49.    A method according to claim 48, wherein said assessing step comprises assessing operational health of each of said teeth.

50.    A method according to claim 48, wherein said gearbox comprises at least two gears that mesh at a meshing point, and said positioning step comprises positioning at least one of said proximeters at a location approximately 180° from said meshing point.

51.    A method according to claim 34, wherein said positioning step comprises attaching said proximeter to a housing having an interior space in which

said rotating machinery is disposed, and a wall defining at least a portion of said interior space and separating said proximeter from said rotating machinery.

52.     A method according to claim 51, wherein at least one of said proximeters is an electromagnetic proximeter, and said positioning step comprises positioning said proximeter in a blind hole that is formed in and extends partially through said wall.

53.     A method according to claim 34, wherein said positioning step comprises exposing at least one of said proximeters to said rotating machinery.

54.     A method according to claim 34, wherein said assessing step comprises comparing said measurements with predetermined values to assess said rotating machinery operational health.

55.     A method according to claim 54, wherein said predetermined values include previously accumulated resonance data, including established maximum values for acceptable machinery fatigue levels.

56.     A method according to claim 55, wherein said resonance data comprises vibration frequency data.

57.     A method according to claim 55, wherein said resonance data comprises circumferential vibration amplitude data.

58.     A method according to claim 55, wherein said predetermined values further comprise values for a radial gap between a gear tooth and a housing in which said gear tooth is housed.

59.     A method according to claim 34, further comprising the step of:

generating an alerting signal that reports said rotating machinery operational health.

60.     A method according to claim 59, wherein said alerting signal comprises instructions for maintaining said rotating machinery.

61.     A method according to claim 59, wherein said alerting signal comprises a textual, audio, or video signal.

62.     A method according to claim 59, wherein said alerting signal automatically halts action of said rotating machinery when said rotating machinery operational health is poor.

63.     A method according to claim 34, further comprising detecting chatter from said rotating machinery using said processor.

64.     A method according to claim 63, further comprising determining a frequency and amplitude of said machinery chatter using said processor.

65.     A method according to claim 64, wherein said processor assessment comprises a lubricity degradation assessment for said rotating machinery based on said machinery chatter data.


66.     A method according to claim 34, wherein said rotating machinery comprises a gearbox comprising a gear having multiple teeth, and said proximeters are spaced at odd harmonics of the resonance frequency quarter wavelength of said teeth.